TECHNICAL REPORT NO. LWL-CR-04C71

AIR ENRICHMENT DESTRUCTION OF DOCUMENTS

FINAL REPORT

By

Ralph H. Allen

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U. S. ARMY LAND WARFARE LABORATORY
Aberdeen Proving Ground, Maryland 21005

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ABSTRACT

Elements of the Department of Defense in the field and at overseas installations require a method for destroying classified material in the event of potential hostile attack. The current method of burning documents requires considerable time and effort, and is without reasonable assurance of maximum destruction.

Under this program, tests were conducted using oxygen as a means of air enrichment to enhance the burning of simulated classified materials. Tests where oxygen was fed into filing cabinets to assist the burning process indicated the average time required for complete destruction varied between 18 to 35 minutes and depends largely on the weight of the material to be destroyed.

FOREWORD

A family of storage containers is needed by the Army to provide improved, lightweight, secure storage for classified defense documents in the field. In addition, there is need for a method of rapid destruction to prevent possible loss or compromise. After the feasibility was demonstrated in response to QMDO for a means of Rapid Destruction and Emergency Destruction of Classified Documents, CDOG, paragraph 1512b(23), an in-house task was initiated for additional testing. This report covers the scope of work performed under that task.

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1.0 INTRODUCTION

A. Background

Military and Government authorities are continually faced with the difficult problem of emergency destruction of classified papers, documents and other intelligence normally on hand or deposited in cabinets or safes. One of the hardest items to totally destroy is bound or packaged paper. Normal burning techniques require constant time-consuming raking or stirring and also require that the papers be hand fed to the fire to insure complete destruction. The shredding method is another technique currently in use; however, it presents a potential hazard to the operator as well as to the equipment. Finely shredded paper becomes highly flammable and explosive. Recently, several personnel were seriously burned because of flash fires occurring during shredding operations.

The military community currently has available several destruct kits which make use of sodium nitrate to assist in the combustion process. These kits utilize up to 50% by volume of the available space in cabinets. Also, when the kits are used, care is required to position the documents and kits to assure total destruction.

In an emergency situation requiring the complete destruction of all documents by existing techniques, valuable time would have to be spent in unlocking the containers, transporting the contents to an appropriate burning area and aiding in the process of destruction.

B. Air Enrichment Technique for Destruction of Documents

The device for the "Air Enrichment Destruction of Documents" is designed for use in standard file type cabinet drawers and will destroy completely all paper documents, data processing cards, tapes, circuit boards and other combustible items currently found in classified containers. Destruction will require approximately 30 minutes. The device may be operated remotely by one person up to a distance of 100 feet from the container and the cabinet need not be open or unlocked to operate the system. A halt in the destruction process before actual ignition is possible, and a restart requires only replacement of the ignition wire. After ignition the destruction process is non-reversible.

The device is compatible with all four and five drawer standard metal classified document file containers and is adaptable for use with the standard Army field safe.

No new skills, knowledge or special training will be required to operate or maintain the device.

Health and Safety Characteristics: Safety precautions required for the destruction device are such that there is no hazard to personnel working adjacent to the cabinets in which the device is installed. When ignited, personnel may be within five feet of the cabinet. However, smoke from the container may contain noxious fumes and the area should be adequately ventilated.

Consideration has been given in the design of the device so that the destruct mechanism may be operated by untrained personnel with minimal instruction.

2.0 SCOPE

A. General

The feasibility of utilizing oxygen to enhance the combustion of documents contained in a type 6 security cabinet has been established. Tests at the close of the program which utilized oxygen introduced at 10 psig pressure indicated the average time for total destruction varied from 18 to 35 minutes depending on the weight of the consumables. On the basis of the tests conducted, it was estimated that approximately 11 pounds of oxygen were required for the complete combustion of 40 pounds of documents.

During the program, the consumables varied conforming to those classified items which are found in various classified containers. A typical composition averaging 40 pounds would consist of:

1. First and second sheets ..... 10 pounds
2. Manila envelopes and folders ..... 10 pounds
3. Carbons, types, envelopes ..... 10 pounds
4. Slate type paper, and newsprints .. 10 pounds

Several tests were conducted in which the consumables were only partly destroyed. It was determined that much of the unconsumed paper consisted of the slate covered paper which formed a hard layer.

From the testing accomplished, the best configuration for the oxygen feed pipe would be a three pronged pipe which would feed the oxygen to the sides and center simultaneously, insuring a constant encircling burn of the material.

B. Description of Material

The safe or cabinet to contain the destruct device required a 5/16" diameter hole drilled through the rear wall of the center and parallel to the surface of the drawer bottom. A tube for the delivery of the oxygen, containing forty 0.1875" (3/16") diameter holes was placed in the bottom of the drawer over a single pyrotechnic igniter device and covered with an expanded metal grid. The end of the tube was directed

through the hole in the rear of the safe. The tube was attached to an oxygen supply. The wires required for activating the igniter were conducted through the oxygen inlet hole to a dc power source. The drawer was then filled in the conventional manner with papers, documents, types, circuit boards or other simulated classified material.

The destruct device was activated without the necessity of unlocking the cabinet. Upon activation of the pyrotechnic igniter, oxygen was simultaneously fed through the oxygen delivery tube located in the bottom of the drawers assisting in the complete destruction of the documents.

C. Material Used

1. Tubing - Copper, 1/4" OD.
2. Pyrotechnic Igniter - Weight approximately 110 grams
   Cellulose container (20 mil)
   50% sodium nitrate
   50% sugar by weight
3. Igniter Wire - Thermalite Igniter Cord
   100 pies Tipo - B
   Manufactured by Canadian Safety Fuse Co., Brownsburg, Quebec
4. Oxygen - Furnished in 1A type cylinders
   Cylinder pressure @ 70^{o}F 2265 psig
   Specific volume @ 70^{o}F and 1 ATM 12/08 ft^3/lb
   Purity - commercial grade
   Cylinder valve outlet CGA 540
5. Regulator - two stage
   Matheson Model 8 (CGA)

3.0 TESTING

A. Discussion

The following is a review of the tests conducted under this task in the evaluation of the air enrichment destruction of documents. This review encompasses discussions on the material used, the various test conditions and the results of some of the material considered pertinent to future tests as applicable to a prototype installation. The technique of air enrichment, while not new in concept, is new to this type of application.

B. Initial Tests

The initial tests were conducted using a standard steel single pedestal office desk which had two locking drawers on the right side. Only the bottom drawer was used. No modification of the desk was made with the exception of the one 4/16" diameter oxygen inlet hole in the center and parallel to the surface of the drawer bottom.

It was decided to review the burning at 15 minute intervals during the allotted 30 minute test period. After 30 minutes combustion was terminated.

During the initial tests it was found that the drawers could not be opened until cooled. The heat of the combustion process had a tendency to warp the sliding rails of the drawers, thus making them inoperative.

Packaged paper assembled in bundles had a tendency to carbonize and form an insulating blanket over the adjoining layers.

It was determined that the igniter required to activate the combustion process could be readily removed without disrupting the tubing or other hardware in the cabinet.

C. Test with Class 6 Security Container

Following the feasibility study using two steel office type desks, the additional testing was conducted using standard Class 6 type security containers. Each test conducted followed the established procedure where practical. In three tests, it was impossible to open the drawers during the test. Later, examination of the drawers of the container showed the heat had welded slide rails together.

Material selected for each test consisted of what might be stored in a typical office classified container. Each segment was weighed individually and separated from the next by the use of manila separators.

The sodium nitrate/sugar igniter mixture is hydroscopic. To overcome moisture pickup, each end of the acetate tube was sealed with cork plugs forming an air tight cylinder. Two igniters were permitted to remain in an exposed damp location for 30 hours prior to use and functioned satisfactorily when ignited.

To insure that the material would be kept in contact with the flames and to break up layers of cinders, three iron rods, 1" diameter and 24" in length were placed on the top of the material. It was noted that during burning the weight of the iron bars pressed the material closer to the flames, thus offering fresh material for combustion. It was also noted that the ash particles were much finer with the bars than noted previously.

Oxygen tubes of different metals used in the test of Class 6 cabinets were:

1. Stainless steel 3/8" OD x 0.049" wall, containing 40 drilled holes 0.013" diameter: the results of this tube were unsatisfactory, as the hole size failed to deliver sufficient oxygen. Burning was minimal.

2. Stainless steel 3/8" OD x 0.049" wall containing 40 countersunk drilled holes 0.0312" diameter: this tube was unsatisfactory for the same reason as No. 1.

3. Stainless steel 3/8" OD x 0.049" wall containing 40 drilled 0.1250" diameter: this tube failed during the burning. It was observed that approximately nine inches of the forward end had been destroyed, creating a "lance effect". Burning of the material was considered minimal.

4. Inconel 3/8" OD x 0.035" wall containing 40 drilled holes 0.013" diameter: this tube failed in the test. Approximately 6" of the forward end was destroyed.

5. Inconel 3/8" OD x 0.035" wall containing 40 drilled holes 0.031" diameter: this tube failed in the test. Approximately four inches of the forward end of the tube was destroyed. It was also observed that approximately 12 holes were plugged from metal slag on the outside of the tube.

6. Stainless steel 3/8" OD x 0.062" wall containing 30 holes drilled 0.0625" diameter: this tube was satisfactory during the test. It was noted that the forward end of the tube was deformed and that the last four holes were plugged with metal.

7. Copper tubing 1/4" OD x 0.030" wall containing 40 drilled holes 0.1875" diameter: this size tubing was found to be very satisfactory for the test. No abnormalities were noted and the hole size did not increase nor was there evidence of the holes filling with metal at the end of the test.

8. Copper tubing 1/4" OD x 0.030" wall containing 30 drilled holes 0.0625" diameter: this tube failed to perform satisfactorily and was discarded.

Tube configurations tested for efficiency and enhancement of the combustion process were as follows:

1. A straight tube with holes equally spaced along 20 inches of the tube from the closed end and located in the tube to provide a 160° fan of oxygen to the combustible contents.

2. A fork type containing two prongs with holes drilled along axis of the tube. The tube had 20 holes, ten on each prong, 0.1875" diameter.

3. A fork type, with three prongs containing 45 equally spaced holes, 15 on each prong, drilled 0.1875" diameter.

Test of Oxygen with Compressed Air:

A series of tests was conducted utilizing compressed air mixed with oxygen to enrich the combustion process. It was observed that although the heat of combustion was enhanced, the center core of the material was still intact. In several tests, the oxygen tube developed the "lance effect" and the use of compressed air was discontinued.

4.0 CONCLUSIONS

A. Operational Concept

This device will destroy classified files, circuit boards (CRYPTO), magnetic tapes and other classified material when time does not permit destruction by normal means.

B. Organizational Concept

It is envisioned that this item could be available to using units through normal supply channels.

C. System Characteristics

1. Three major components
2. Weighs 65 pounds excluding oxygen cylinder
3. Will meet all environmental requirements with a shelf life estimated at more than five years.
4. Assembly or disassembly time of 30 minutes.
5. May be used with or without electrical power.
6. Expendable
7. Impact insensitive when assembled
8. 99% reliability with 90% destruction
9. Destruction time of 30 minutes
10. Destruction can be accomplished in place; however, the heat of fire precludes access to safe five minutes after ignition
11. Capable of being activated by one individual
12. Training time for use and assembly is approximately one hour.

5.0 RECOMMENDATIONS

A. Additional testing should be conducted utilizing oxygen as the base gas in conjunction with other compounds to enrich the combustion process.

B. Investigate the potential of various oxygen feed arrangements for the interior of the drawers.

C. Develop a hardened prototype kit for operational evaluation, which would incorporate a positive safety device to preclude accidental premature functioning.

APPENDIX A

Test 6 May 1970

1.0 Equipment Used:

Fuel: Propane cylinder, 2 each, 14.1 ounce by weight (1 pint, 10.7 fluid ounces).

6 ft. hose, polyethylene

One propane burner head (Bernzomatic)

Four foot aluminum tubing (1/8" inside diameter)

One air valve, 1/4"

Three adapters, 1/8" x 1/4" inside diameter

Three tee's, 1/4"

One adapter, 1/4" to plastic tubing connector

One steel desk, two drawer type with rubber top

2.0 The Test:

2.1 Contents

Nine packages of two types of paper (1# Xerox type and reproducible drafting paper 1#) were assembled into packs, each weighing approximately 2.5 pounds. Eight packs were tied with cotton cord and one pack was sealed in plastic and taped shut. Total weight was 22.5 pounds.

Three 1/4" holes had been previously drilled in the side of the desk permitting the burners to extend over the center of the large drawer.

2.2 Procedure

The burners were lit and placed in the holes in the side of the desk and the cylinder valve turned full on. A visual check was made of the process at the end of the first 5 minutes and it was determined that although the heat from the torch was intense, total combustion would not occur. It was noted that considerable charring had taken place and that the paper was not damaged except on the edges (1/2" in from the edge). The same condition was found to exist at the 10 minute mark, except that the charred portion of the paper backs had grown inward approximately another 1/4". It was also noted that several of the outside sheets of each packet had been completely destroyed.

With a new cylinder of propane, the burning was again started and timed. The cylinder was permitted to burn wide open until exhausted, The time to deplete the cylinder was 13 minutes. Further charring took place, but in no case were the packets completely destroyed. The outside burning had increased to approximately 2 inches on the top of the packets with a depth of 1 1/2" on the side. When the second cylinder was completely exhausted, the test was stopped.

Test 21 May 1970

1.0 Equipment Used:

Same as the test of 6 May, plus one cylinder of oxygen.

2.0 The Test:

2.1 Contents

Ten packages of two types of paper, comparable to that used in the first test were placed in the test drawer. The approximate weight of the paper was 30 pounds. Five pounds of computer readout charts were placed in the top narrow drawer directly over the test drawer.

2.2 Procedure

For this test, one additional hole, 1/2" in diameter had been drilled in the middle of the back at the base so that a copper tube carrying the oxygen could be fed to the under side center of the bottom drawer.

The propane burners were lit first and allowed to burn for approximately one minute and then the oxygen (at approximately 14 pounds/square inch gage pressure) was permitted to flow into the base of the drawer. It was observed that when the oxygen was fed to the desk that the intensity of the heat waves doubled. The drawer was not opened until 10 minutes had lapsed. It was observed on opening the drawer, that the entire perimeter of the paper packages had been consumed to the average depth of over one inch. All of the cardboard spacers and other material that had been placed in the drawer had been consumed.

The flow rate of the oxygen was then increased to 20 psig and again it was noted that the heat waves increased in size. The propane cylinder was exhausted after 21 minutes of use and the oxygen cylinder was cut off. When the drawer was opened, it was noted that an intense fire was still burning but in approximately three minutes it started to subside. A measurement of the packages of paper revealed that a depth of two inches had been reached on the charring and this was projected on three sides. It was estimated that the oxygen had increased the burning efficiency approximately 25-30%.

3.0 Recommendations:

It was recommended that additional testing be conducted. Further testing should be conducted using a perforated false bottom with numerous holes thus permitting the flow of oxygen to pass upward through the paper. It is believed that the flow of oxygen will aid the combustion process when fed directly into the papers. It is further recommended that the oxygen flow rate remain the same as well as the amount and type of paper thus providing a comparison between the tests.

Test 17 July 1970

1.0 Equipment Used:

Same as 21 May 1970 test except for steel grate, 1/4" thick, 12" x 20" set on three 1" angles giving 1 1/4" clearance above the base of the desk drawer.

2.0 The Test:

2 1 Contents

Ten packages of two (2) types of paper comparable to that used in the first two tests weighing approximately 20 pounds were placed on the steel grid that was supported by three angles of aluminum. Five pounds of computer readout sheets were placed in the small top drawer directly over the test drawer.

2.2 Procedure

For this test, an additional hole, 1/4" in diameter, was drilled directly above the previous hole (1") to permit the oxygen tube access to the drawer. The tube was inserted until it reached the mid-point of the drawer. This permitted the oxygen to feed directly to the center portion of the stacked paper. The propane burners were lit and allowed to burn freely for the period of one minute and then the oxygen was turned on and permitted to flow at approximately 8 psig pressure. It was observed that although the paper was burning, the intensity of the fire tripled with the introduction of the oxygen. This was judged solely by the heat waves in the air and the heat felt by the observers. At the end of five minutes, the flow of oxygen was increased to approximately 12 psig pressure and the intensity of the fire again increased.

After 30 minutes from the start of ignition the propane was shut off and the fire was fed oxygen only.

Ten minutes after ignition, the oxygen was shut off and the tubes removed. It was noted that some slag had dropped from the front of the drawer and that the drawer was fused to the desk. The drawer was forced partially open and it was noted that the combustion of the papers far exceeded that which had been accomplished prior to the current test. It is estimated that the technique of forcing oxygen up through the papers increased the burning efficiency approximately 50%.

Test 27 October 1970

1.0 Equipment Used:

The igniters used in this test were fabricated from cellulose acetate but were of the same weight and composition as that used in the previous test. The paper composition was the same. For this test the oxygen tube was placed in the channel of the drawer reaching to the front of the drawer and was permitted to move freely when the drawer was opened. The grill used did not have stand off feet and was permitted to lie flat on the bed of the drawer.

2.0 The Test

2.1 Procedure

Operation was started at 1300 hours. Oxygen was fed continuously to the drawer at 25 psig pressure and the combustion process was permitted to burn for 15 minutes. The oxygen was then shut off and the drawer opened for inspection. It was observed that the grill of expanded metal was cherry colored to white in the center of the drawer and that the periphery of the paper had been completely destroyed. The center section of the paper, approximately 6 inches in diameter, was still white and showed no evidence of burning at this time.

The drawer was then closed and the oxygen flow was increased to 50 psig pressure and allowed to burn for an additional five minutes. The oxygen was then shut off and the drawer was re-examined. Difficulty was experienced in opening the drawer and it required a bar to pry the drawer open. The base of the front end of the drawer was almost completely destroyed and only a thin layer of metal remained on the front of the drawer. It was also noticed that the entire bottom of the drawer had been destroyed (as a quantity of the residue of the burning paper fell to the ground). When the oxygen tube was removed, it was found to be 18 inches shorter than the original length. There is the possibility that the oxygen tube acted as an oxygen lance, thus the amount of destruction that took place when the drawer was closed. An estimate of combution is approximately 60% of the 40 pounds of material in 20 minutes.

3.0 Recommendations

It is recommended that additional burn be accomplished utilizing stainless steel tubing for conveying the oxygen, but the diameter of the holes remain the same, and the angle of the ports be at 45 degrees instead of the 90 degrees.

Test 4 April 1971

1.0 Equipment Used:

The test was conducted using an ignition mixture similar to the previously conducted test but of reduced quantity. Total weight of the cellulose acetate igniters was 90 grams. The composition was made of 50% sodium nitrate and 50% sugar by weight. For this test, one igniter was placed in each drawer under the perforated metal plate as in previously conducted tests (see Figure 1 and Figure 2). Combustible material for each drawer contained 30 pounds of assorted paper consisting of 10 pounds of brochures and magazines, 10 pounds letter type stationary and 10 pounds of carbons, drawings and second sheets. Oxygen was supplied to the four drawers through a brass manifold (Figure 3). The oxygen tubes to each drawer containing 40 1/16" holes were closed at one end. The holes in the tube were equally spaced along 20 inches of the tube from the closed end and located in the tube to provide a 160° fan of oxygen to the combustible contents of each drawer.

2.0 The Test

2.1 Procedure

The test was started utilizing only the top drawer (Figure 4). As soon as the drawer showed evidence of ignition, oxygen was fed to the drawer at 20 psig pressure for a total of fifteen minutes and then shut off. It was noticed after eight minutes that the front of the drawer showed a high degree of heat discoloration (Figure 5), and shortly afterward there was a red glow at the base of the drawer. It was believed that the end of the oxygen supply tube burned away resulting in the "lance effect" taking place. Upon opening the drawer, it was apparent that only 40% of the contents had been consumed. The front part of the drawer containing an asbestos compound had been destroyed by the "lance effect" (Figure 6). It should be noted that this part of the drawer was directly in front of the oxygen tube.

The test of the second drawer had the oxygen fed at a reduced rate of 10 psig pressure but the burning time was increased to 30 minutes. At the termination of the time, the drawer was opened and it was determined that the lance effect had taken place but on a lesser degree. The center of the grid had been destroyed and also a small area of the front of the drawer, but there was no discoloration to the outside of the drawer. On removing the oxygen tubes from both drawers, it was observed that the tube from the top drawer was deformed and shortened and the tube from the second drawer was deformed on the end but was not shortened (Figure 7). The contents of the second drawer had been approximately 50% destroyed. However, the center section of the paper was not charred and could be read.

It was determined for the remaining two drawers to vary the conditions of burning as well as employ different methodology by the following:

a. The contents of No. 3 drawer would be placed flat instead of vertical with equal distribution of the types of paper.

b. No. 4 drawer would have the contents remain vertical but would have four pieces of 3/8" iron bars, 18 inches in length placed on top of the paper. Each bar weighed approximately four pounds.

c. The oxygen pressure feeding the cabinet would be reduced to 5 psig.

d. The burning time would be one hour and both drawers together.

The burning was started with a full cylinder of oxygen and with both drawers of the cabinet shut tight. Following ignition and the start of combustion, it was observed that white smoke issued from the cracks along the sides of the drawer. It was also noted that there was evidence of water dripping from the base of both and along the channel recesses in the front. At the end of the burning time, No. 3 drawer was opened and it was observed that approximately 60% of the material had been consumed. Burning had progressed on all sides but the core of the paper was still intact and legible.

Drawer No. 4, the bottom container, when opened gave evidence of 90% total combustion (Figure 8). It was observed that in the center of the drawer there was an open channel between the two center iron rods and it extended from the front to the rear approximately four inches in width. This channel was believed caused by the turbulence of the oxygen issuing from the tube. It was also believed that the iron rods sided in the combustion by forcing the paper downward as it was consumed.

3.0 Recommendations

It is recommended that additional testing be conducted utilizing the iron bars as used in Drawer No. 4 with consideration given to the possible use of a venturi to promote additional flow of air thus enhancing the oxygen in combustion and creating additional turbulence.

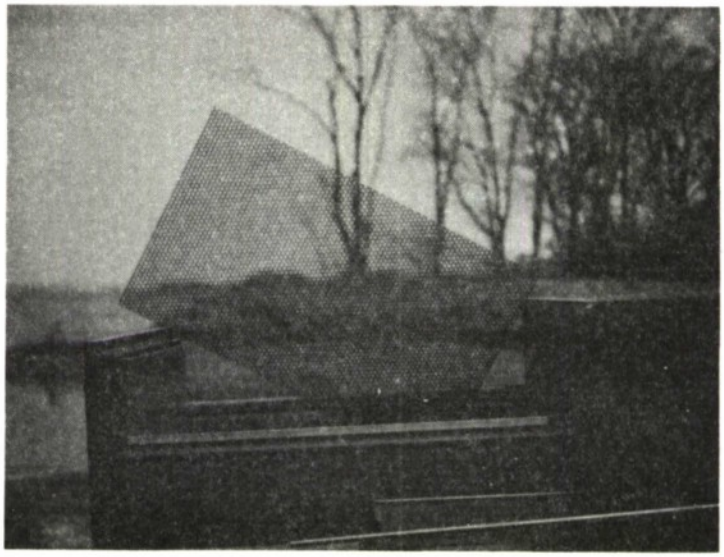

Figure 1. Expand Metal Grid

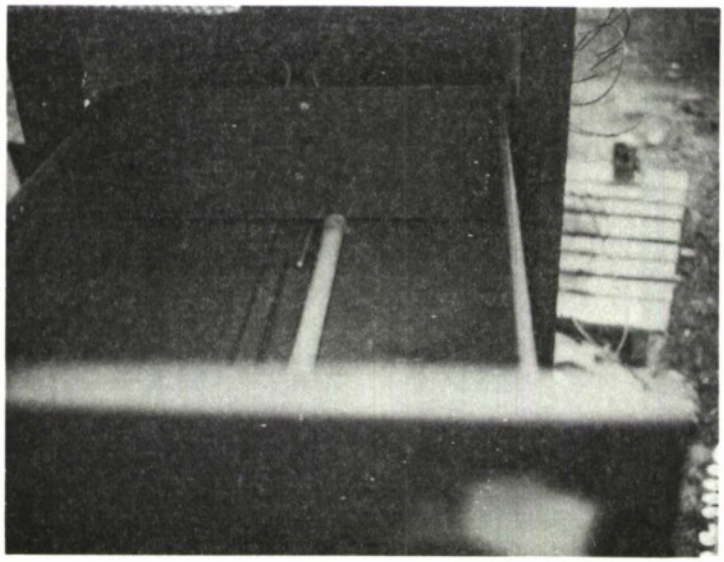

Figure 2. Position of Igniter

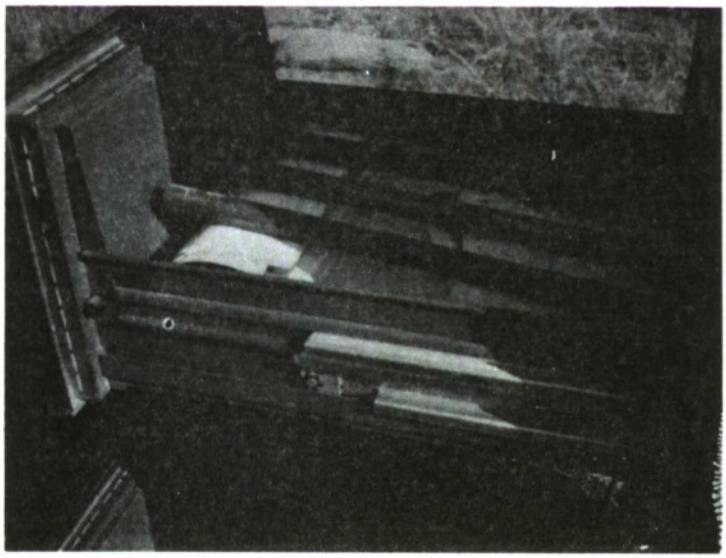

Figure 3. Material Loaded in Drawer

Figure 4. Evidence of First Ignition

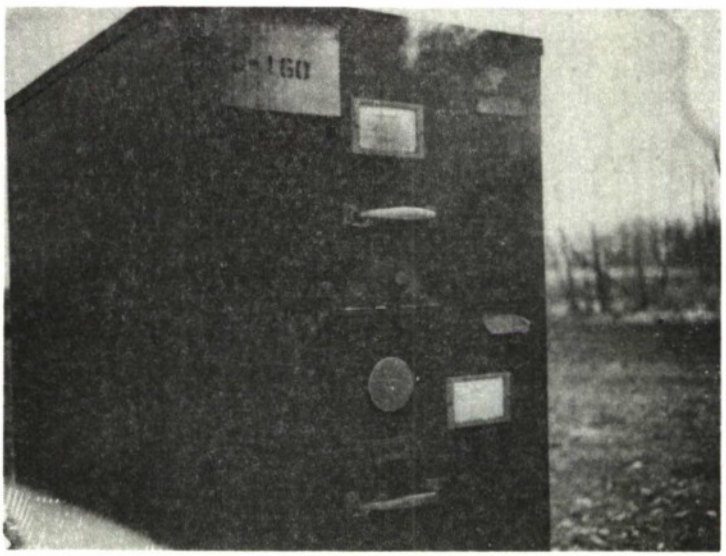

Figure 5. Front of Face of Cabinet Showing "Lance Effect"

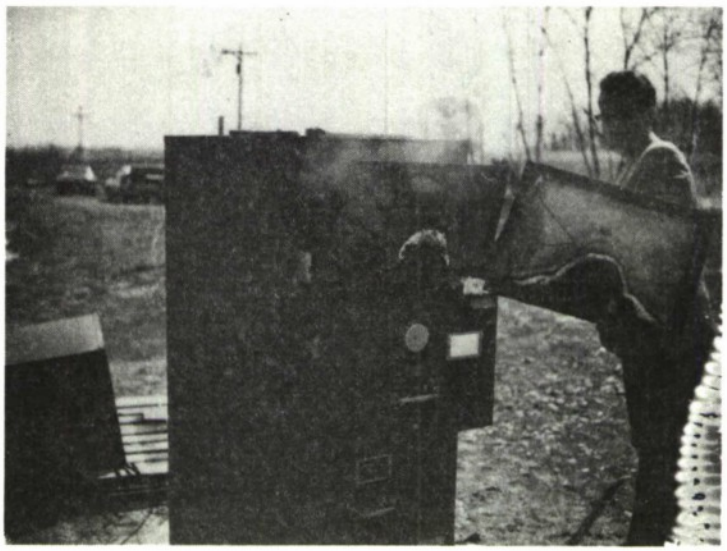

Figure 6. Front of Drawer Showing Effect of Oxygen Lance

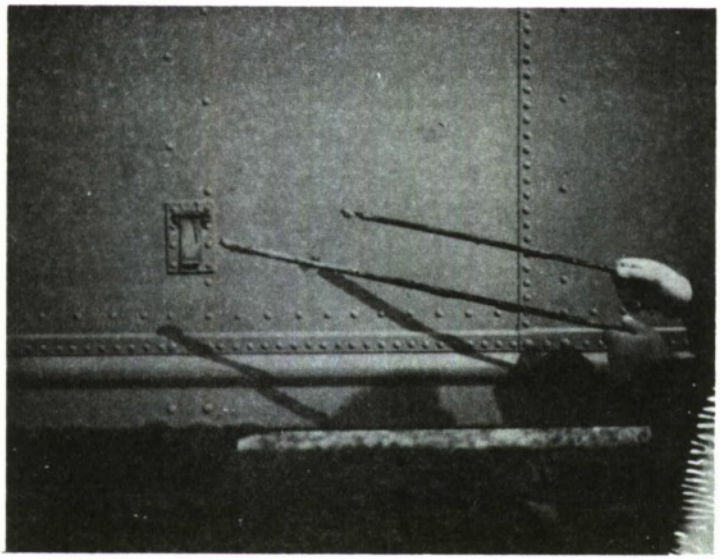

Figure 7. Showing Destruction of Oxygen Tubes

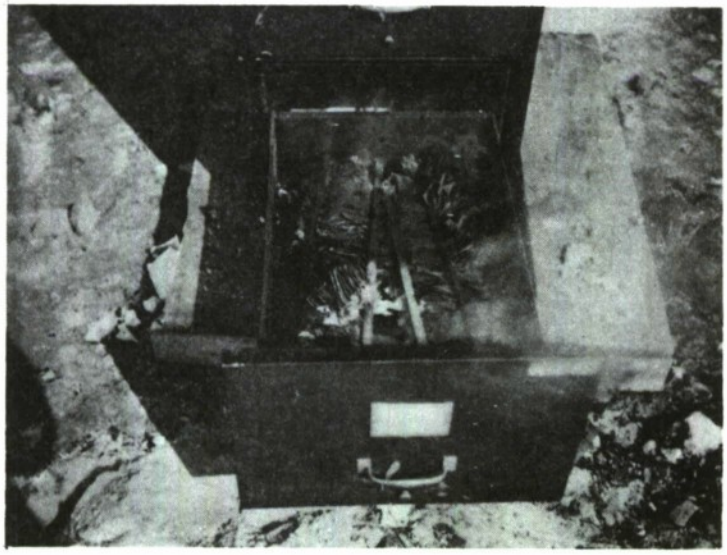

Figure 8. Condition of Consumables after First Period of Combustion

Test 21 October 1971

1.0 Equipment Used:

The test was conducted using similar facilities as used in previous tests. The total weight of the cellulose acetate igniters was 108 grams each composed of 50% sodium nitrate and 50% sugar by weight. Combustible material for each drawer contained 20 pounds of computer data run out sheets and 10 pounds of brochures and magazines.

2.0 The Test

2.1 Procedure

Oxygen was supplied to the four drawers through a brass manifold. The oxygen tubes to each drawer were closed at one end, containing 40 1/16" holes. The holes in the tube were equally spaced along 20 inches of the tube from the closed end and located in the tube to provide a 160° fan of oxygen to the combustible contents of each drawer.

The test was started utilizing four drawers at the same time. As soon as all the drawers showed evidence of the igniter burning, the oxygen was fed to the drawers at 20 psig for a total of 30 minutes and shut off. Upon forcing open the drawers, it was apparent that the center of the combustible material had been destroyed but the top and sides had remained intact and were partly legible.

As all four drawers each contained 30 pounds of material prior to ignition, the remaining paper was weighed to determine per cent of combustion. The following approximated weights were obtained for each drawer:

	Pounds Unconsumed	Percentage
Drawer #1	11	36%
Drawer #2	9	30%
Drawer #3	13	43%
Drawer #4	12	40%

Test 18 November 1971

1.0 Equipment Used:

The test was conducted using the safe/container that was used in the 21 October 1971 test. The cellulose acetate igniters weighed 110 grams each composed of 50% sodium nitrate and 50% sugar by weight. As individual drawers were used, oxygen was supplied to the drawers through a brass manifold. The tube to each drawer tested was the same tube used in the previous test. In addition, compressed air was fed to the drawer by means of a 18" copper tubing 0.1250 I.D. which paralleled the oxygen tubing. The test material for the first drawer consisted of 30 pounds of data sheets placed at a 15° angle in the drawer on top of an expanded metal grid. The second drawer contained 15 pounds of magazines and the same amount in data-runout sheets. The iron bars previously used as weights were not used in the first drawer.

2.0 The Test

2.1 Procedure

The test was started utilizing the top drawer. As soon as the drawer showed evidence of the igniter burning the oxygen was fed to the drawer at 20 psig pressure with the compressed air fed at 30 psig pressure. The drawer was partially opened at the end of 15 minutes and it was noticed that the top part of the material was burning and the sides had been consumed for approximately 1" on both sides. The drawer was closed and burning continued for 15 minutes and then shut off. Examination of the drawer disclosed that the material was burned completely on the bottom but the center portion of the data sheets were legible. During the burning, it was apparent that the closed end of the oxygen tube burned off and the compressed oxygen and air resulted in the "lance effect" as the front inside end of the drawer was completely destroyed.

In the test of the second drawer, the three iron weights were used. The oxygen pressure was decreased to 10 pounds and the air pressure at 30 psig pressure. It was noted that the burning process was far more intense and greater heat was generated from the 3-1 ratio of air to oxygen. At the end of 15 minutes the drawer was opened and the combustion observed. It was apparent that the flames from the oxygen and air had spread out on the bottom of the drawer and the four sides of the drawer showed evidence of being consumed. It was also apparent that the iron weights forced the material closer to the flames. The drawer was then closed and burning allowed to continue for 15 minutes more, and then shut off. It was noted that approximately 70% of the material was consumed; however, the center portion of the material was still legible and readable. It was also noted that the oxygen tube was burned off at approximately midway in the drawer and the front of the drawer destroyed the same as the first test.

3.0 Recommendations

It is redommended that the next test have a shorter tube incorporating a series of holes 0.1875" diameter with an air inlet into the oxygen tube thus permitting a mixture of oxygen and air at a 3 to 1 ratio, to the material surface. The three weights and material as used in the last test should be used.

Test 14 January 1972

1.0 Equipment Used

The test was conducted using the classified container that was used in the 18 November 1972 test. The igniters were of the same mixture (50% sodium nitrate and 50% sugar by weight) and weighed 110 grams. The oxygen and air pipe contained 20 holes with a diameter of 0.1875" diameter. In this test only one drawer was used at a time and the tube conveying the oxygen and compressed air was supplied through the manifold. The test material for each drawer consisted of 30 pounds of data sheets, magazines and first and second sheets of letter material. Iron bars previously used as weights were emplaced over the test material.

2.0 The Test

2.1 Procedure

The test was started utilizing the first (top) drawer. As soon as the drawer showed evidence of combustion oxygen and compressed air were fed to the drawer at 20 psig pressure each. The drawer was partially opened at the end of 15 minutes and it was noticed that the top part of the material was burning and the sides of the material were burned to approximately one inch.

The drawer was closed and burning continued for 15 minutes more and then both air and oxygen were shut off.

Examination of the drawers disclosed that the material was burned completely on the bottom approximately 1 1/2" deep, the sides burned approximately 1" and the top charred. The center portion of the material showed no evidence of burning.

In the test of the second drawer, the test material and iron weights were the same. However, the oxygen and air pressure were reduced to 10 psig each.

At the end of 15 minutes, the drawer was opened and the combustion process observed. It was noted that the heat of the combustion had been increased over that of the first drawer and more combustion of the material was in process. The drawer was closed and burning allowed to continue for 15 minutes and then shut off.

Examination of the drawer disclosed that approximately 70% of the material was consumed but the center section of the material was legible and showed no evidence of discoloration.

3.00 Recommendations

It is believed that a tube conveying oxygen only and forked to cover both sides of the drawer should be investigated. It is also believed that the hole size 0.1875" diameter is satisfactory. No change in the materials or ignition system should be made.

Test 17 February 1972

1.0 Equipment Used

The test was conducted utilizing the same safe/container as used in the previous test. The cellulose acetate igniters weighed approximately 110 grams and contained 50% sodium nitrate and 50% sugar by weight. Only one drawer was utilized and a copper tubing 0.259" diameter containing 20 holes 0.1875" diameter was fashioned in a fork permitting 10 holes on each side of the drawer. The weight of the material used was approximately 30 pounds.

2.0 The Test

2.1 Procedure

Oxygen was fed to the drawer directly without the manifold at 10 psig pressure when the igniter showed evidence of combustion.

At the end of 15 minutes, the drawer was opened and it was observed that more combustion of the sides of the material had taken place than on previous tests. The flames from the two tubes created an over lapping effect on top of the material.

The drawer was closed and burning permitted to continue for 15 minutes. The oxygen was shut off and the drawer opened. It was noted that a hard core of material still remained in the center but much of the sides showed evidence of heavy charring and combustion. It appeared that a minimum of 70% of the paper was consumed by this method.

3.0 Recommendations

It is recommended that the next test utilize a forked tube but with an additional tube direct on the center to attempt to burn the center section of the material.

Test 20 March 1972

1.0 Equipment Used

The test was conducted using the classified container used in the previous test. However, for the test only one drawer was utilized. The igniter was of the same mixture (50% sodium nitrate and 50% sugar by weight). Approximate weight was 112 grams. For this test, a pitch fork type pipe to deliver the oxygen was fabricated. The pipe was 1/4" diameter and sealed at the ends. The 45 holes, 0.1875" diameter drilled in the pipe were spaced equally along the axis, 15 holes on each of the "tines". The material for the test consisted of a total of 30 pounds of data sheets, first and second sheets of letter material including five pounds of assorted brochure material and five pounds of magazines (slate faced).

2.0 The Test

2.1 Procedure

The test was started with the wind toward the safe and the oxygen turned on at 15 psig when there was evidence that the igniter was burning. It was noticed that when the oxygen was introduced into the safe, a muted roar was heard and the density of the smoke increased.

The drawer was partially opened at the end of 15 minutes and it was observed that the entire top of the material as well as the sides had been consumed. As the tubing did not reach to the front end of the drawer, the material was burned on the sides and top but the front was still intact. As the arrangement of the material prevented the emplacement of the three iron bars at the onset of the test, the bars were placed in the drawer at this time and the drawer closed. It was also noticed that the outside of the safe was cool to touch.

At the end of the second 15 minutes, the oxygen was shut off and the drawer examined. It was estimated that 80% of the material had been consumed. Only a small portion approximately three inches high and four inches square remained solid to touch and the interior was still legible. It was believed that the triple fork pipe aided in the combustion of the material.

REFERENCES

1. AR 71-1, Force Development, Army Combat Developments, as amended.

2. AR 705-5, Research and Development of Materiel, Army Research and Development, as amended.

3. AR 705-13, Research and Development of Materiel, Research, Development, Test and Evaluation of Physical Security Equipment.

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13. ABSTRACT

Elements of the Department of Defense in the field and at overseas installations require a method for destroying classified material in the event of potential hostile attack. The current method of burning documents requires considerable time and effort, and is without reasonable assurance of maximum destruction.

Under this program, tests were conducted using oxygen as a means of air enrichment to enhance the burning of simulated classified materials. Tests where oxygen was fed into filing cabinets to assist the burning process indicated the average time required for complete destruction varied between 18 to 35 minutes and depends largely on the weight of the material to be destroyed.

DD FORM 1 NOV 68 1473 REPLACES DD FORM 1473, 1 JAN 64, WHICH IS OBSOLETE FOR ARMY USE.

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14. KEY WORDS	LINK A		LINK B		LINK C	
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Air Enrichment						
Destruction						
Combustion						
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Destroy						
Ignition						
Igniter						
Classified Cabinets						
Classified Containers						
Consumables						
Pyrotechnic						